PATENT ABSTRACTS OF JAPAN

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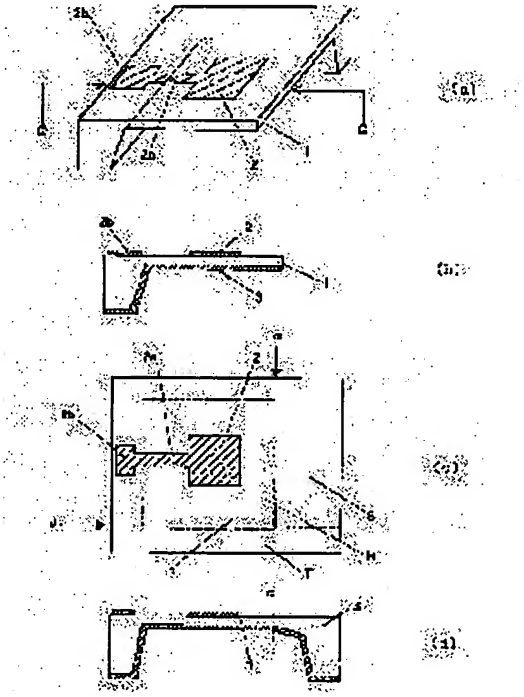
(54) PIEZOELECTRIC DEVICE

(57)Abstract:

PROBLEM TO BE SOLVED: To obtain a means that downsizes a high frequency piezoelectric vibrator or a high frequency dual mode piezoelectric filter.

SOLUTION: The down-sized high frequency piezoelectric vibrator configured by arranging a counter-electrode to a piezoelectric substrate formed with a recessed part can be formed by cutting off a slope caused when the recessed part is formed by etching the piezoelectric substrate and at least one surrounding part connected to the slope.



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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Field of the Invention] Especially this invention relates to the miniaturized high frequency piezo-electricity device about a high frequency piezo-electricity device.
[0002]
[Description of the Prior Art] Since the dual mode piezo-electricity filter (a duplex mode filter is called hereafter) using a high frequency piezo-electricity device especially a quartz resonator, or the Xtal substrate has small, a light weight, and the frequency temperature characteristic that was excellent while it was strong, it is widely used for the terminal of a cellular phone in recent years. Drawing 5 (a) and (b) are the top view showing the configuration of the duplex mode filter which used Xtal sheet metal, and a sectional view in Q-Q, respectively. It connects with the electrode pads 52b and 53b by the side of the flat surface of the Xtal substrate 51 in which the cavity 50 was formed on one main front face which extended the lead electrodes 52a and 53a in the center towards the edge of the Xtal substrate 51, respectively from these electrodes 52 and 53, and were mostly prepared in it at the heavy-gage part of the Xtal substrate 51 while carrying out contiguity arrangement of the electrodes 52 and 53, respectively. On the other hand, the whole surface electrode 54 is adhered to the cavity side of the Xtal substrate 51, and the duplex mode filter of a RF is constituted. In addition, the Xtal substrate 51 shown in drawing 5 carries out the cavity of one main front face of an AT cut Xtal substrate with a thickness of about 80 micrometers using FOTORISO technique and the wet etching technique. While carrying out to the thickness of a request of this cavity (thin-walled part) 50, for example, the shape of about 10-micrometer sheet metal, (oscillating section), the heavy-gage annular surrounding section which supports the perimeter of a thin-walled part is formed in one with a thin-walled part, and it is considering as the Xtal substrate holding the mechanical strength of a thin-walled part.
[0003] Although two or more thickness-slip-vibration modes are excited on the Xtal substrate 51 shown in drawing 5 (a), 0th symmetric-vibration mode (S0) and the 0th antisymmetrical state oscillation mode (A0) are excited by stress with electrodes 52 and 53, and the duplex mode filter using the two oscillation modes (resonance frequency fs and fa) is constituted by giving suitable termination. Here, it is known well that the pass band width of a duplex mode filter will become twice [about] the difference (fa-fs) of two resonance frequency depending on the gap between the thickness of the cavity (oscillating section) 50 of the Xtal substrate 51, the amount of frequency falls of electrodes 52 and 53 and two electrodes 52, and 53 in resonance frequency fs and fa.
[0004] While drawing 6 (a) is drawing for explaining the process which forms the RF Xtal substrate 51 shown in drawing 5 and using and adhering vacuum evaporationo equipment or a sputtering system in a golden thin film all over the big AT cut Xtal substrate (wafer) 61 If the resist film is applied on this thin film, this resist film is exposed through a mask and it exfoliates using a remover, the thin film of the gold with which the desired configuration was located in a line in the shape of MATORISUKU will be formed. If a substrate 61 is immersed and etched into the etching reagent which uses ammonium fluoride as a principal component after dissolving the thin film of this gold with an aqua regia etc. and

exposing the Xtal substrate, the wafer 61 with which the shape of a matrix was located in a line by each substrate which has a cavity as shown in drawing 6 (a) will be obtained. Although drawing 6 (b) is the sectional view which expanded each RF substrate 62 formed on the wafer 61 and it consists of a thin-walled part 63 and the annular surrounding section 64 holding this thin-walled part 63, if it investigates in a detail, a thin-walled part 63 consists of a flat part (oscillating section) 65 and a ramp 66, and the cavity side of the annular surrounding section 64 consists of side attachment walls 67 and 68 different mutually [a tilt angle]. For example, the opening dimension W0 is set as the 80-micrometer Xtal substrate 1 with 1.392mm as thickness t. When it etches until the thickness of a thin-walled part 65 is set to 10 micrometers, Z' shaft-orientations dimension W1 of a thin-walled part 65 0.9744mm, Inclination partial Z'Z with which shaft-orientations dimension W2 united 0.0696mm, and inclination part and ramp 66 of side-attachment-wall side 68 of another side' shaft-orientations dimension W3 of one side-attachment-wall side 67 is set to 0.348mm.

[0005]

[Problem(s) to be Solved by the Invention] However, although it is necessary to make small the width method of the annular surrounding section, and the dimension W0 of opening if it is going to miniaturize the RF Xtal substrate shown in drawing 6 (b) Since it has the etching pattern of a proper since an AT cut Xtal substrate is an anisotropy crystal, and the dimension W2 of Z'Z of dimension W3 [of shaft orientations] and side attachment wall 67' shaft orientations of a ramp 66 and a side attachment wall 68 is proportional to the amount of etching of X shaft orientations of a cavity, Even if it made the dimension W0 of opening small, when the depth investigated by etching was the same, it was not different from an above-mentioned value, the dimension W1 of a flat part 65 became smaller than the reduction percentage of a dimension W0 relatively, and the dimension of W2 and W3 had the problem that a miniaturization was very difficult. It is made in order that this invention may solve the above-mentioned problem, and it aims at offering the miniaturized high frequency piezo-electricity device.

[0006]

[Means for Solving the Problem] Invention of the high frequency piezo-electricity device applied to this invention in order to attain the above-mentioned purpose according to claim 1 While forming an electrode in the flat-surface side of the piezo-electric substrate in which the cavity was formed to one field and extending a lead electrode from this electrode to the edge of said substrate While cutting the ramp of the cavity formed in case said piezo-electric substrate is etched into a cavity side in the piezoelectric transducer equipped with the whole surface electrode from a boundary with the flat part which is an oscillating field It is the RF piezoelectric transducer characterized by cutting at least one of the annular surrounding sections from a boundary with a flat part. While invention according to claim 2 approaches and forms two electrodes in the flat-surface side of the piezo-electric substrate in which the cavity was formed to one field and extending a lead electrode from this electrode to the edge of said substrate, respectively While cutting the ramp of the cavity formed in case said piezo-electric substrate is etched into a cavity side in the dual mode piezo-electricity filter equipped with the whole surface electrode from the flat part which is an oscillating field It is the RF dual mode piezo-electricity filter characterized by cutting at least one of the annular surrounding sections from a boundary with a flat part.

[0007]

[Embodiment of the Invention] This invention is explained to a detail based on the gestalt of operation shown in the drawing below. The perspective view showing the configuration of the RF piezoelectric transducer which drawing 1 (a) requires for this invention, and this drawing (b) are the top views for explanation and sectional views for the sectional view in alignment with Q-Q, this drawing (c), and (d) to cut a ramp and the surrounding section S, and the surrounding section T. An electrode 2 is formed in the flat-surface side of the Xtal substrate 1 in which the cavity was formed to one field, while extending to pad electrode 2b which prepared lead electrode 2a in the edge of the Xtal substrate 1 from this electrode 2, the whole surface electrode 3 is adhered to a cavity side, and a RF quartz-resonator component is formed. Furthermore, as shown in the top view and sectional view of drawing 1 (c) and

(d), while cutting the ramp of a cavity, and the surrounding section S from the boundary alpha with the flat part H which is an oscillating field If while it is parallel to lead electrode 2a cuts the surrounding section T using dicing etc. along the boundary beta with a flat part H, the RF piezoelectric transducer which constituted the oscillating section of thin meat and the heavy-gage supporter of the letter supporting this of the abbreviation for L characters in one as shown in the perspective view of drawing 1 (a) will be obtained. The description of this example is having attained the miniaturization of a RF piezoelectric transducer by cutting a part of annular surrounding section which is the ramp and attaching part which are not an oscillating field.

[0008] Drawing 2 is drawing having shown an example of the process which forms the RF piezoelectric transducer of this invention shown in drawing 1 . Drawing 2 (a) exfoliates the surface film for every predetermined spacing using photolithography technique, after adhering a golden thin film to the front rear face of a wafer 11. And the part which is predetermined and which the Xtal side exposed as it was shown in drawing 2 (b), when time amount immersion was carried out is etched into an etching reagent in the exfoliative wafer, and a cavity is formed. After this cavity is formed, if a flat-surface side on the back forms the desired electrode 14 for the whole surface electrode 15 using photolithography technique, it will become a sectional view as shown in drawing 2 (c) at a cavity side. And the RF piezoelectric transducer component shown in drawing 2 (e) is obtained by cutting in Rhine C shown in drawing 2 (d). Drawing 2 (f) is the perspective view reversed so that a flat-surface side might turn up.

[0009] Drawing 3 is drawing showing the configuration of the 2nd example concerning this invention, and a sectional view [in / drawing / this / (a) / in a perspective view and this drawing (b) / Q-Q] and this drawing (c) are top views for explanation for cutting a ramp and the surrounding section. To the flat-surface side of the Xtal substrate 1 in which the cavity was formed on one main front face, it approaches and two electrodes 32 and 33 are arranged, while even the pad electrodes 32b and 33b which formed the lead electrodes 32a and 33a in the edge of the Xtal substrate 1 from these electrodes 32 and 33, respectively extend, the whole surface electrode 34 is adhered to a cavity side, and a RF duplex mode filter component is formed. while cutting the ramp and the surrounding section S which are not the oscillating field formed in the cavity like the case of drawing 1 from the boundary alpha with the flat part H which is an oscillating field -- a part of annular surrounding section -- T is cut from the boundary beta with a flat part H, and a small RF duplex mode filter is formed.

[0010] Drawing 4 is drawing showing the configuration of the RF piezoelectric transducer of the 3rd example concerning this invention, and a sectional view [in / drawing / this / (a) / in a perspective view and this drawing (b) / Q-Q] and this drawing (c) are explanatory views for cutting a ramp and the surrounding section. A different place from the thing of drawing 1 is having attained the miniaturization of a RF quartz resonator further by having cut the surrounding section parallel to lead electrode 42a along with both beta1 and beta2, and having constituted the oscillating section of thin meat, and the heavy-gage supporter of a streak of letter supporting this of the abbreviation for I characters in one. Thereby, although the reinforcement of the oscillating section of thin meat falls a little, the further miniaturization is realizable. Moreover, it cannot be overemphasized that this example is applicable also to a duplex mode filter and the Mie mode filter.

[0011] Although this invention was explained using the AT cut Xtal substrate above, it is not necessary to explain that the Xtal substrate of other cutting include angles may be used. Moreover, if this invention is applied to lithium tantalates other than Xtal, langasite, lithium tetraborate, etc., a small piezo-electric device will become possible. Moreover, although each is cut in the above-mentioned example on Boundaries alpha and beta, if the thin-walled part is supported by the heavy-gage part of the shape of I characters or L character in one, it cannot be overemphasized that a cutting plane may be suitably set as locations other than alpha and beta.

[0012]

[Effect of the Invention] Since this invention was constituted as explained above, according to invention of claim 1, it has the outstanding effectiveness that the configuration of a RF piezoelectric transducer can be sharply made small. Moreover, according to invention of claim 2, there is outstanding effectiveness that the configuration of a RF dual mode piezo-electricity filter can be sharply made small.

[Translation done.]

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1] The perspective view showing the configuration of the RF piezoelectric transducer which (a) requires for this invention, and (b) are top views for a sectional view, (c), and (d) to explain cutting of a part of ramp and surrounding section.
[Drawing 2] (a) The sectional view explaining the process in which - (e) forms the RF piezoelectric transducer of this invention, and (f) are perspective views.
[Drawing 3] (a) is a top view for the perspective view showing the configuration of the RF dual mode piezo-electricity filter of the 2nd example concerning this invention and (b) to explain a sectional view, and for (c) explain cutting of a part of ramp and surrounding section.
[Drawing 4] (a) is a top view for the perspective view showing the configuration of the RF piezoelectric transducer of the 3rd example concerning this invention and (b) to explain a sectional view, and for (c) explain cutting of a part of ramp and surrounding section.
[Drawing 5] The top view in which (a) shows the configuration of the conventional RF dual mode piezo-electricity filter, and (b) are the sectional views in Q-Q.
[Drawing 6] The perspective view showing the configuration of the RF piezo-electricity substrate formed in the big AT cut Xtal substrate (wafer) in the shape of a matrix and (b) of (a) are the sectional views showing the configuration of the cavity of the RF piezo-electricity substrate of the piece of an individual.
[Description of Notations]
1 41 .. Piezo-electric substrate
2, 14, 15, 32, 33, 42 .. Electrode
2a, 32a, 33a, 42a .. Lead electrode
2b, 32b, 33b, 42b .. Pad electrode
11 .. Wafer
12 13 .. Thin film
H .. Flat part
S .. A ramp and the surrounding section
T .. Surrounding section
alpha, beta, beta1, beta2 .. Cutting plane line

[Translation done.]

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CLAIMS

[Claim(s)]
[Claim 1] It is the piezo-electric device which is equipped with the oscillating section of thin meat, and the heavy-gage supporter of the letter of the abbreviation for L characters which supports a part of rim of this oscillating section, and is characterized by said oscillating section and supporter consisting of piezoelectric material in one.
[Claim 2] It is the piezo-electric device which is equipped with the oscillating section of thin meat, and the heavy-gage supporter of a streak of letter of the abbreviation for I characters which supports a part of rim of this oscillating section, and is characterized by said oscillating section and supporter consisting of piezoelectric material in one.
[Claim 3] The piezo-electric device according to claim 1 or 2 characterized by having been constituted so that one main front face of said oscillating section and one principal plane of said supporter might turn into the same flat surface, and forming a whole surface electrode in the flat surface concerned and the field which counters.

[Translation done.]

JAPANESE [JP,2002-033640,A]

CLAIMS DETAILED DESCRIPTION TECHNICAL FIELD PRIOR ART EFFECT OF THE INVENTION TECHNICAL PROBLEM MEANS DESCRIPTION OF DRAWINGS DRAWINGS

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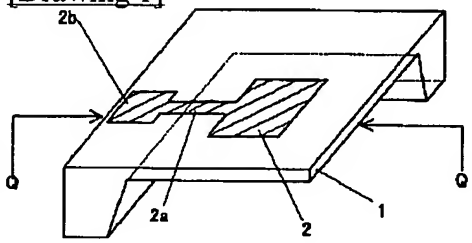
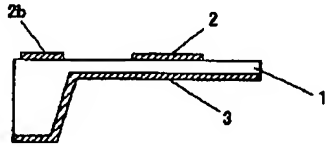
DRAWINGS

[Drawing 1]



(a)



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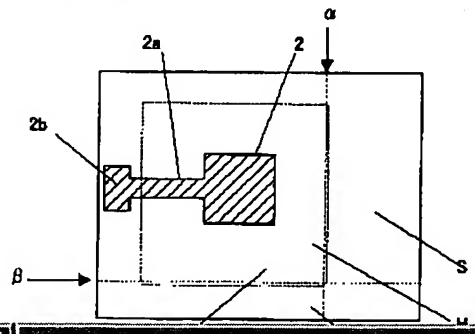
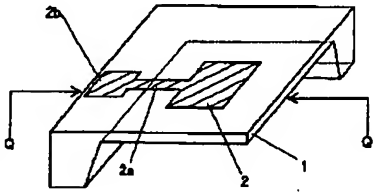


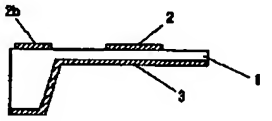
(c)

Drawing selection

Representative drawing



(a)



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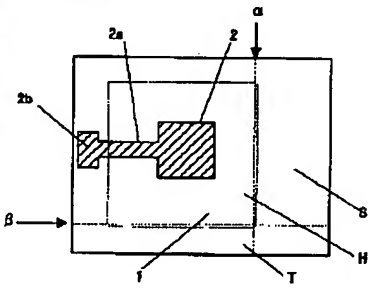

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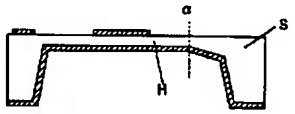

(d)

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